

PATENT SPECIFICATION  
DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Inventory Control System and Apparatus

We, BREWER PHARMACAL ENGINEERING CORPORATION, a corporation organized and existing under the laws of the State of Pennsylvania, United States of America, of 9138 West Chester Pike, Upper Darby, State of Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention hereinafter described and claimed is directed to inventory control systems and apparatus, and while useful in a wide variety of applications, it is especially useful in hospitals for providing effective control of drug inventory and charges and for effecting more efficient operation of the various hospital services connected with drug management, such as the pharmacy, nursing and accounting. Therefore, in the following description, the invention is set forth in terms of such use, although it should be clearly understood that this is exemplary and that the invention is not to be considered so limited. In the accompanying drawings:

Figure 1 is a general perspective view of the apparatus of the invention including the drug cart and the drug station;

Figure 1A is a perspective view of a charge voucher;

Figure 2 is a perspective view of the drug station in accordance with the invention with parts broken away to show various internal details thereof;

Figure 3 is a sectional view taken on line 3—3 of Figure 2;

Figure 4 is a schematic of the primary components of the drug station;

Figure 5 is a front view of the recorder with parts broken away to show various details thereof;

Figure 6 is a sectional view with parts [Price 4s. 6d.]

broken away of the article ejecting mechanism in its inoperative or ready condition; 45

Figure 7 is a view similar to Figure 5 but showing the article-ejecting mechanism in its operated condition;

Figure 8 is a fragmentary plan view of the drug selection key means and showing a drug identifying key; and 50

Figures 9—22 are schematics of the control circuits.

Referring now to the drawing, and first to Figures 1—4, and with reference to the primary components of the apparatus and their respective functions, it is seen that they include a drug cart 1 and a drug station 2.

The cart includes a plurality of individually patient drawers 3 each having handle means 4 upon which the patient's name, room number, etc. is attached under a clear window. Also included in the cart are drawers 5 and 5A for nurse's records and floor stock, or the like, and drawer 6 for narcotics. The top of the cart provides the nurses' working area 7 and compartments 8, 8A and 8B for syringes and other articles. Rollers 9 permit the cart to be easily moved about by the nurse, while lock means 10, 10A are provided to lock all drawers simultaneously thus to prevent unauthorized access to the drugs in the drawers.

The drug station includes a housing 11 having a storage compartment 12 for drugs, divided into a plurality of smaller compartments or bins 13, one for each type of drug, (Figures 2, 3 and 4) and each having an ejector mechanism 14, as shown more specifically in Figures 6 and 7, operable to discharge drugs from the storage compartment 12 through a discharge chute 15 (Figure 3) to a receiving station 16 opening to the exterior of the housing 11. Sensing means 17, a photocell apparatus in this embodiment, is located in chute 15 to detect the passage

of a drug through the chute and, as herein-after described, cause actuation of the recorder 18 (Figures 2 and 5). Console 20 (Figure 2) houses the drug key plates 21, see Figure 8. Charge-vouchers "V" (Figure 1A) are stored in compartment 22 and after being recorded, as described later, portions V1 and V2 thereof are slipped into a compartment 23 provided with a slotted locked door for this purpose, while portion V3 is attached to the drug package ejected. Suitable electrical circuitry, described herein-after, enables actuation of the drug station.

More specifically, each bin 13 and its ejection mechanism, as seen in Figures 6 and 7, comprises vertically positioned walls 24 loosely surrounding the articles 25—drug packages in this embodiment—so that after one (25A) is ejected from the bottom of the stack into chute 15 (Figure 3), those remaining will drop downwardly to position the next succeeding package for ejection. Pivotally mounted as by pin 26 on opposite side wall flanges 27, only one being shown, is an "L-shaped" ejector 28 having rear and bottom walls 29 and 30 respectively. The lowermost package 25A rests upon bottom wall 30, while rear wall 29 terminates below the top edge of the package. A wire spring 32 formed in an upwardly extending loop 34 has its ends wrapped around pin 26 and secured to bottom wall 30, as at 35, in a manner biasing loop 34 against the back surface of rear wall 29 of the ejector 28, but out of contact with package 25B, for the purpose explained hereinafter. Secured to the rear wall 24R of bin 13, as by bracket 37, is a solenoid 38 having its armature plunger 40 normally biased downwardly as by coil spring 52. Pivoted to the bottom of the plunger 40 by a pin 44, is an arcuately shaped arm 46 having its other end 46 secured to rear wall 29 of ejector 28.

In the operation of the ejector mechanism, an electrical pulse, as described later, energizes solenoid 38 to draw plunger 40 upwardly, as seen in Figure 7, during which movement arm 46 rocks the L-shaped ejector 28 clockwise about pin 26 to throw out the lower package 25A.

During this movement the upper end of spring loop 34, is brought into contact with and urges the next succeeding package 25B against the front wall 24F of the compartment with sufficient force to hold it and the remaining packages from dropping until the solenoid spring 42 returns the plunger to its downmost position, as seen in Figure 6. Note that rear wall 24R of the compartment terminates short of spring loop 34 to permit access thereto to package 25B. Energization of the solenoid is only momentary and plunger 40 and spring loop 34 are quickly returned to their inoperative position, ejector 28 being stopped in position to receive package 25B, as by stop pin 48, in which position spring loop 34 is out of contact with package 25B which now drops into ejector 28. Front wall 24F of the ejector bin may be pivotally mounted (or removable) to provide access to the interior of the bins for loading of drugs in the bins. In some cases spring 34 may be eliminated and packages 25B and up may be supported by arcuate link 46, as indicated in broken lines. As another alternative both may be used.

In accordance with this preferred form of the invention, key means having indicia thereon is provided to select the ejector mechanism 14 for discharge of a particular drug. Actuation of the ejector mechanism may be effected only with the key means in the recorder 18 (Figure 5). The recorder operates, as described later, only in response to the discharge of a drug to make a record of the indicia of the key means. By this arrangement drugs can only be issued when the recorder is conditioned to make a record and accordingly there is a record of each drug ejected from the apparatus. In the present illustrated form of the invention, the key means comprises a drug plate 21 for each drug (Figures 2 and 8), a patient plate 54 from his own individual drawer 3 in the drug cart (Figure 1), and a nurse's plate 56 (Figure 5), each having indicia thereon identifying respectively the drug, the patient, and the nurse.

While these key plates may take other shapes, in the present embodiment they are thin, flat plates with raised indicia. The drug plate compartment is connected, for example, through a suitable electrical selector circuit (as described later) to the ejecting mechanism 14 whereby removal of a selected one of drug plates 21 from compartment 20 selects the solenoid 38 (Figure 6) for actuation of the ejector mechanism for the bin 13 containing the selected drug. The drug, patient, and nurse plates, which constitute the key means, are then inserted in a control shuttle 62 (Figures 2 and 5) slidably mounted in housing 64 of recorder 18, which includes a record medium, such as tape 66, for receiving the indicia information from the key means upon delivery of a drug package. The control shuttle 62 is actuatable from an outer position exteriorly of the housing, as seen in Figure 2, for receiving the key means, to (and from) an inner position interiorly of the recorder (Figure 5) wherein the key means is disposed to transfer the indicia information to the tape upon actuation of the recorder. Movement of the shuttle to its inner position causes each plate to close an associated switch in circuit means, described hereinafter, to condition the apparatus for operation. Actuation of a start button 67 now

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will actuate the selected ejector mechanism 14, as described later, to discharge the selected drug. Upon discharge of the drug, the sensing means 17, in the present embodiment a photocell light beam 68 in the discharge chute, is interrupted to actuate a recorder switch which causes the recorder to operate and make a record of the indicia on the key plates both on tape 66 and a voucher V. Accordingly there is a record of each drug issued, and if for some reason the selected drug is not discharged, no record is made.

Referring now to Figure 5, it will be seen that the recorder comprises generally a tape supply roller 70 mounted on a wall 71 for carrying a roll of pressure sensitive tape 66. That is, a tape which in response to pressure will reproduce indicia impressed thereon. Such a tape includes two separable layers 72 and 74, chemically cooperating under pressure to reproduce the indicia upon the inner surface of layer 74.

The tape is fed from roller 70 to the left over idler roller 76, downwardly over idler rollers 78 and 80 where the layers separate, to the right over key plates 56, 21 and 54, shown in shuttle 62, then under pressure of printing roller 82, over idler 84, through jaws 86 and 88 of tape feeder 90, around idler rollers 92, 94, 96 and 98, to take-up rollers 100 and 102.

Printing roller 82 is carried by a rocker member 83 pivotally mounted, as by pin 105, on a block 104 slidably mounted with a predetermined frictional resistance on a pair of bearing rods 106 and 108 for reciprocatory movements, as by crank 110 and connecting rod 112 driven by a motor 114 through shaft 116. The connecting rod 112 is pivotally connected at its left end to rocker 83 as by pin 118. The motor is energized, as described later, to effect one complete revolution of crank 110 to move block 104 to the left to cause printing roller 82 to roll over the key plates in the shuttle 62 and impress their indicia upon tape 74, and then to the right to return to its initial position. As illustrated, print roller 82 is in its starting position, that is, the motor has already started. During this initial movement to the left the forces of connecting rod 112 against rocker 83 has urged the rocker member 83 in a counter-clockwise direction until stopped by adjustable pin 119, and are such as to hold roller 82 down tightly against the key plates thus to effect recording on the tape. On the return movement, however, the forces are reversed and rocker 83 rotates clockwise to move the print roller out of contact with the tape during the return.

A similar but opposite action is effected on paper feed jaws 86 and 88. Initial movement of block 104 to the left, causes link 120 to rock crank arm 122 carrying jaw 86 in a counter-clockwise direction about pivot pin 124 thus to move jaw 86 upwardly and away from jaw 88 which is fixed to block 125 slidably mounted on the base or frame member 126 secured to wall 71 of the recorder. This movement separates the jaws so they can move freely during the printing cycle of the recorder without moving the tape. Conversely, when the block 104 begins its rightward or return movement, link 120 rocks crank 122 clockwise causing jaw 86 to move downwardly to grip the tape between itself and jaw 88. Continued movement to the right effects feed of the tape sufficiently to bring an unrecorded portion thereof over the key means. Take-up rollers 100 and 102 are driven from motor 114 by a belt drive (not shown) or other means connected thereto by suitable friction clutch means.

Means to indicate when the tape on supply roller 70 is almost exhausted is provided by feeler arm 128 pivotally mounted to wall 71 on pin 130 and biased against the tape. Means, not shown, but secured to the other end of the pin 130 is effective through suitable circuitry, described later, to energize an indicator lamp 132 on the exterior of the recorder housing (Figure 2), and simultaneously render the apparatus inoperable, as described hereinafter, until the tape supply is replenished.

The recorder is also provided with a slot 134 (Figures 1 and 2) whereby the above-mentioned charge-voucher "V" (Figure 1A) may be inserted for recording thereon of the indicia on the key means simultaneously with the recording thereof on the tape. When inserted, the voucher is positioned between tape layer 74 (Figure 5) and key plates 56, 21 and 54.

In operation of the system, the nurse's key plate, the drug key plate and the patient's key plate are inserted side-by-side in the shuttle 62. It should be noted that the proper bin has been selected when the drug plate is withdrawn from its slot 60 in the console 20. The nurse takes a charge-voucher "V" from the storage compartment 22 and places it on the shuttle over the plates in registry with the slot opening 134 in the charge recorder (just above the shuttle on which she has placed the key plates), and then slides the shuttle into the recorder (Figure 5). When the conditions thus far outlined have been met an electrical start light circuit is energized, as described later, and a start light under start button 67 (Figure 2) comes on to notify the nurse that the apparatus is ready to issue the selected drug. Thereafter the nurse merely depresses the start button which through an appropriate electrical circuit, hereinafter described, actuates the selected ejector mechanism 14

to discharge the selected drug through chute 15 to receiving station 16.

When start button 67 is depressed, an electrical replace-plate circuit is energized lighting the replace-plate indicator window 142 which remains on until the nurse replaces the drug plate after the selected drug has been dispensed. If the supply of the selected drug is exhausted from its respective bin when the nurse depresses the start button, an electrical "empty" circuit energizes an empty light 144 to show the operator that the selected bin is empty. If the selected drug is issued, container 25 on its passage through chute 15 interrupts the photocell light beam 68 which, through a circuit described later, actuates charge recorder 18 to transcribe the information from the drug, patient and nurse's plates to both the record tape 74 and charge-voucher "V" (Figure 1A). Incidentally, those portions of the charge-voucher marked "C" are carbon paper. The identification label V3 of the voucher is then removed and applied to the drug container ejected. The other copies are slipped through slot 23A into compartment 23. When the charge recorder cycle is completed, the nurse retracts the shuttle to the outer position, removes drug plate 21 and replaces it in its respective slot 60 in the drug plate compartment to condition the apparatus for another ejection cycle. The other two plates are returned to their storage. If she neglects to return the drug plate and attempts to lock the panels, or if she mistakenly removes a second drug plate without returning the first, an error light 146 and a buzzer within the station are energized, as more fully described hereinafter, informing her that this is improper.

#### Operation Circuits

When the drug plate door 19 is closed, door switch SW2 is held by the door in its closed condition, as shown by solid line in Figure 9 and no drug plate is removed (DSW-1 in broken line condition), only relay K11 (hereinafter designated "sensing relay") is picked or energized.

For proper operation of the equipment, the following must be performed: the drug plate door must be opened, opening SW2 (Figure 9) and deenergizing K11; a drug plate is withdrawn closing DSW-1 picking K11 to close switch K11-1 (Figure 12) which supplies the voltage required to operate the equipment. The drug key plate, a patient key plate, and a nurse's key plate must be placed into the shuttle 62. The shuttle must then be inserted into the charge recorder 18 thus to close switches SW7, SW9 and SW10 (broken line condition). With this completed, the start light under start button 67 will be energized to indicate the equipment is set up and ready to operate. The circuit operates

as follows: (See Figure 12) With the drug, patient, and nurse's key inserted in the shuttle, switches SW7, SW9 SW10 are closed and the circuit is from the AC line (at right of the figure) through switch K3-2, in series with parallel switches K1-4 and K2-4, then through SW6, K3-1, K11-1, SW10, SW9, SW7, K4-4, relay K15 to AC common, thus picking the start light relay K15 to close switch K15-1. As seen in Figure 13, relay K5 is already energized by the door being opened, thus the circuit is completed through K5-3 and K15-1 energizing the start light. After the completion of a cycle, relay contact K4-4 is opened, as described later, preventing the start light relay from being re-energized until the equipment is set up for another cycle.

When the start button is depressed, start relay K7 will be energized (see Figure 19), completing the circuit from the AC line through K7 as follows: AC line through K3-2 closed, through K1-4 and K2-4 in parallel and closed, through SW6 (tape out switch), through K3-1 closed, through K11-1 normally opened, now closed through switches SW10, SW9, SW7, normally open, now closed, through K4-1 closed, through K5-1 now closed, through SW8 (start switch) now closed, through K8-3 closed, to K7 and then the AC common, picking K7.

When the start button is depressed, start relay K7 will be energized which will cause bin solenoid relay K6 (Figure 17) to be momentarily operated by displacement current through capacitor C1. Relay K6 will close a circuit that will operate the bin solenoid (Figure 16), and when relay K7 picks, K7-2 contacts (Figure 17) will close. Closing of the K7-2 contacts will cause the displacement current to flow from the positive side of the power supply, through K7-2, K6 and capacitor C-1 to the negative side of the line. The surge of current will continue until the capacitor charges. During the initial surge, ejector coil K6 will pick, and when the capacitor starts reaching full charge, K6 will then drop out.

For the period of time that K6 is picked, a circuit to the selected bin solenoid will be completed. The circuit (Figure 16) is from the AC line through K3-2, through K1-2 and K2-4, in parallel, through tape-out switch (SW6), through K3-1 through K11-1, now closed due to one plate being removed, through K6-1 which is picked while the capacitor is charging, through the selected drug plate switch DSW-1, through ejector solenoid 38 to the AC common. Energizing the solenoid will eject the item in the bin, as described above.

When K7 picks, as above described, in addition to picking of relay K6, relay K4 (Figures 18 and 21) will also be picked to open K4-1 inhibiting K7 (Figure 19) at

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the same time K4-2 will complete the circuit to energize replace light 142 and open start circuit K7 (Figure 19) to prevent repeated ejection of drugs in the event the start button is held down by the nurse. When chute switch K16-1 (Figure 22) is closed by the ejected item, a circuit is completed that will start the charge recorder operation. Figure 22 shows the charge recorder operation after the 10 start button is depressed.

The contact K7-4 will energize relay K10 which will close contact K10-1. This contact will cause the motor to operate the charge recorder for one cycle, when the motor will 15 open the circuit by means of switch CSW operated by a cam on the motor shaft, which picks K8 to open K8-2, dropping out K10 to open motor switch K10-1.

If a drug plate is removed from the drug 20 plate holder, and the drug plate door is closed without replacing the drug plate, an error circuit (Figure 10) will be energized. When the error circuit is completed, an error light will be energized (Figure 11) 25 and at the same time a warning buzzer "Z" is sounded. The circuit is as follows: (remember that when the door is closed, the current flowing in the circuit is sufficient to pick K11 only), if at the same time 30 a drug plate is removed, this will result in the two resistors R1 and R2 being in parallel as seen in Figure 9, and 9A causing an increase in the current flowing through the circuit. This increased current will result 35 in K12 picking also. When K12 is picked, the error circuit will be energized (Figure 10).

Relays K1 and K2 are the error relays, and are energized as follows: when K12 40 is energized, a circuit is completed from AC line to K12-1, K12-2, through the contacts which are now transferred completing a circuit to K1 and K2, thus picking these relays. Relays K1 and K2 are held by the following 45 circuit: AC line to K3-2, closed, to K1-4, and K2-4 to coils of K1 and K2. Relay K3 is a cascade relay and will not be energized if any drug plate is missing.

Picking relays K1 and K2 will energize 50 the error buzzer and error light. At the same time, as seen in Figure 11, the circuit that picks K11 and K12 (Figure 9) is opened through contacts K1-1 and K2-1 resulting in K11 and K12 being deenergized.

The error light and buzzer are energized 55 with the circuit shown in Figure 11, as previously described.

The empty circuit is used to indicate the fact that a selected item has been depleted. 60 The indication of an empty bin will be the energizing of the "EMPTY" and "ERROR" lamps, 144 and 146 respectively. The error circuit will not sound the buzzer as a result of the empty indication.

In a normal operation, when the nurse's 65 key, patient plate, and drug plate is inserted into the shuttle, the shuttle is then moved into the operating position in the charge recorder. When this is done, the start light comes on indicating that the unit is ready to operate. When the start button is depressed, an item is ejected by the unit, the item operates a chute switch which starts the charge recorder operation. At the completion of the charge recorder cycle, the unit must be cleared before operation can be resumed.

When the unit fails to eject an item or if the stock is depleted, the photo-cell chute switch 17 will not be operated and the empty circuit is operated as follows: when the start button is depressed, relay K7 will 70 be energized closing contact K7-1 (Figure 14) which will result in the heating element (R) being heated. The heating will continue unless the chute switch 17 is operated, which will open the heating circuit through the operation of the charge recorder K10-4. The heating element will cause a bi-metallic strip to operate a contact point (VT-1, Figure 15). When this contact closes, relay K9 is 75 energized. When K9 is energized, it will hold through the K9-3 contact and the K1-4, K2-4, and K3-2 contacts. When K9 picks, K9-3 contact will close the circuit to the error relays K1 and K2. When the drug plate is replaced, relay K3 will pick resulting in the relays K1 and K2 dropping out.

The interlock relay K4 is used to prevent 80 the possible issuing of more than one item with each operation of the equipment. It will be seen that after the start button (SW8, Figure 19) is depressed, relay K7 will pick, ejecting an item. When the unit ejects an item, relay K6 will pick K4 relay. With relay K4 picked, the circuit for operating the start relay is open due to contact K4-1 being opened. It is not possible to operate the circuit again until relay K4 is reset. Relay K4 is reset when all the drug plates have 85 been returned to the drug plate holder. With all plates in the drug plate holder, relay K3 (cascade relay) will be energized (Figure 20). When relay K3 is energized, relay K4 will be reset as shown in Figure 21. The design of the relay will permit the full transfer of the relay before contact K4-3 is broken.

When a drug ejected from the device has 90 been returned unused, it may be desired to credit an account for the unused drug and a credit key plate is then used in the shuttle instead of the drug plate. It is possible however by simultaneously removing a drug plate from the console 20 to issue a drug package with a credit record. To prevent such tampering a validating mechanism 95 (Figure 5) is provided on the recorder to indicate both on the tape and the voucher when a drug has actually been ejected. This mechanism comprises a validating stamp 100 105 110 115 120 125 130

on a rotor 156 pivotally mounted, as by shaft 158, on base 160 of the shuttle. On the left-hand end of the shaft 158 is a depending link 162 by which the shaft may be rotated to move the stamp 154 into recording position as indicated by the broken line showing 82A of roller 82. Rotation is effected by a solenoid 164 which is energized, as seen in Figure 19 simultaneously with the start relay K7.

**WHAT WE CLAIM IS:—**

1. A dispensing system for stored goods including a storage for the goods and means for ejecting the goods from the storage, comprising key means stored in a compartment which is electrically connected with a compartment containing the items to be dispensed and removal of key means from its storage electrically selects an ejector mechanism in the item compartment for operation and insertion of at least the same key means in an energizing circuit operates to electrically condition the ejector to dispense the selected item.
2. A system according to claim 1, in which the electrically conditioned ejector is activated to dispense the item by the operation of a starting switch.
3. A system according to claim 1 or 2, wherein the system thereafter is inoperative for further dispensing until said key means is returned to storage.
4. A system according to claim 1, 2 or 3, wherein the energizing circuit includes a recorder into which said key means is inserted, and the item after it is dispensed triggers a circuit to actuate said recording means to record information contained on said key means.
5. A system according to claim 4, wherein said key means comprise at least two key plates and the recorder is not operable for recording until all of the key plates are positioned in a shuttle and the shuttle is shifted into the recorder.
6. A system according to claim 4, wherein the recorder includes a tape recorder and means responsive when the tape is exhausted to inactivate the system, the recording taking place by pressure of the tape on the key means.
7. A system according to any one of the preceding claims, including error indicating means to signal removal of more than one of said key means from their storage compartment.
8. A system according to claim 7, wherein the error means includes a circuit having two impedances connected in parallel with two relays connected in series such that the removal of the one key means energizes one

relay and the removal of another key means energizes the other relay whereupon the circuit is completed.

9. A system according to any one of the preceding claims, wherein in addition to said key means at least one other key means comprising a plate having recordable information indicia thereon is inserted into the energizing circuit to actuate the ejector.

10. A system according to any one of the preceding claims, wherein there are a plurality of key means in a single storage compartment and each key means controls the selection and dispensing of an item stored in the item storage compartment.

11. A system according to any one of the preceding claims, wherein the ejector is mounted at the bottom of a bin containing the items to be dispensed, one arm of the ejector supporting the items and another arm being operatively connected with means to tilt the supporting arm of the ejector thereby dispensing an item, and means associated with the ejector to press against the next succeeding item to restrain it from falling until the ejector returns to its starting position.

12. A system according to claim 11, wherein the means associated with the ejector is a third arm which is arranged upwardly and is moved into contact with the next succeeding item when the supporting arm is tilted and the first item is dispensed.

13. A system according to claims 4, 5 or 6, wherein said recorder includes feeding and take-up spools for recording tape and a roller to press the tape against recording means, further comprising shuttle means for moving key means into and out of the recorder transversely to the movement of the tape means for advancing the tape across the key means and means for urging a roller on the tape against the key means for recording, said roller being moved transversely across the key means from first to second terminal positions.

14. A system according to claim 13, wherein the advancing means advances the tape incrementally during the return movement of the roller.

15. A system according to claim 13 or 14, wherein the roller is pivotally mounted on means which is slidably mounted on a guide passing over the key means, and said means is also connected to driving means to drive the means and the roller over the key means.

16. A system according to claim 15, wherein the mounting means is also attached to connecting means to open or close a pair of jaws which cooperate to advance or hold the tape.

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17. A dispensing system substantially as herein described with reference to the accompanying drawings.

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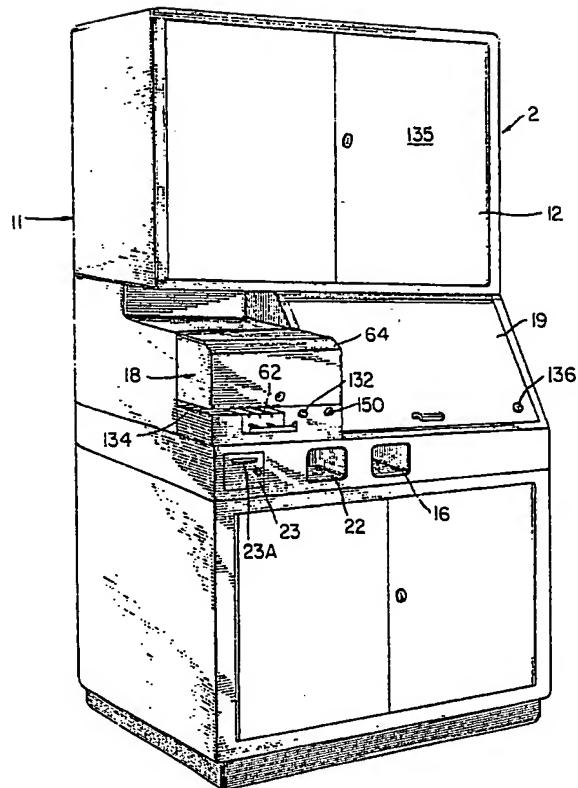


FIG. I

FIG.1A

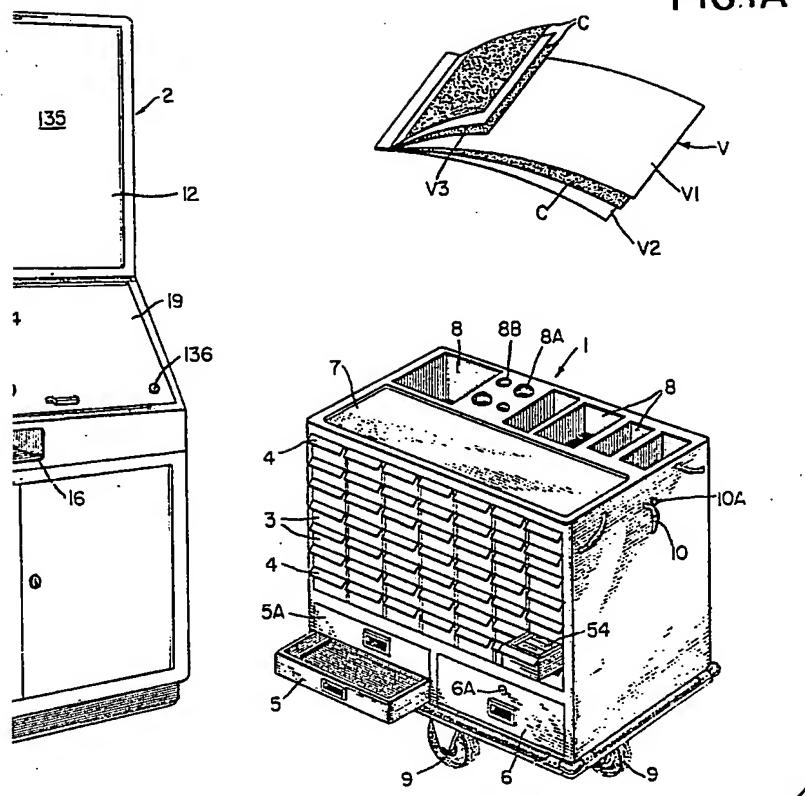


FIG.1

FIG. I A

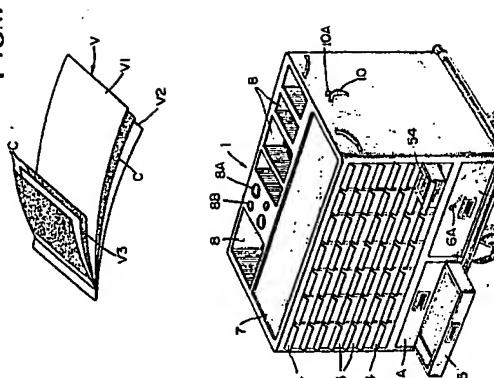
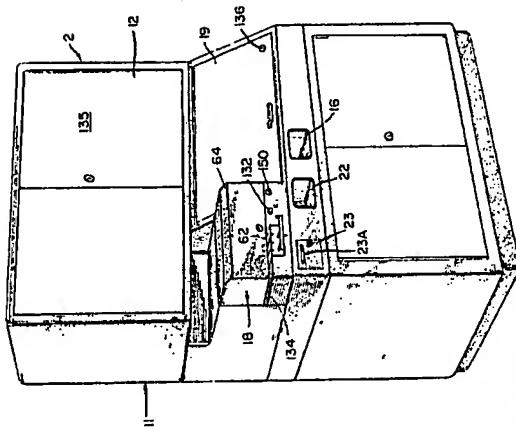


FIG. I



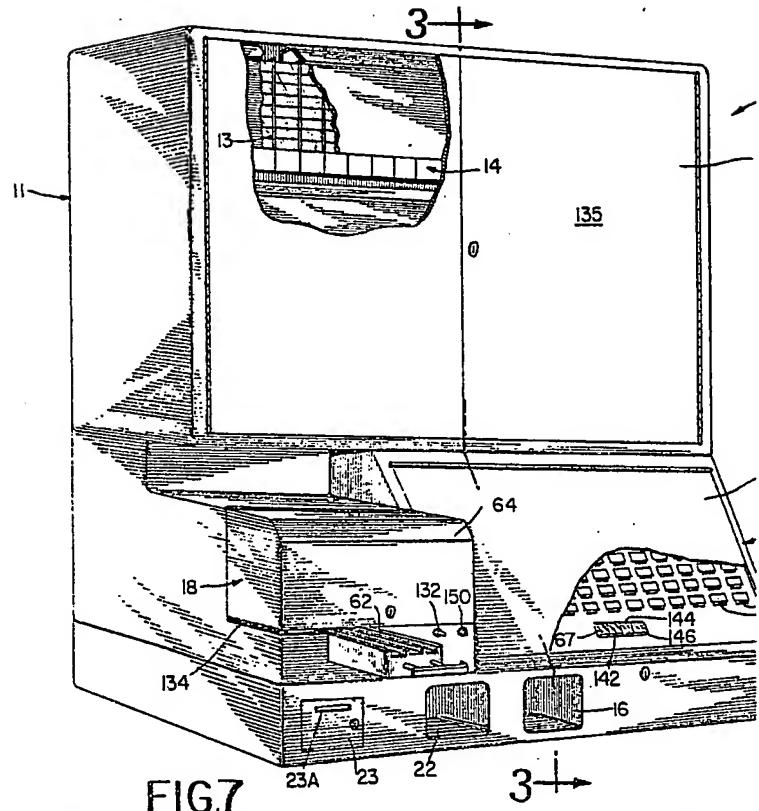
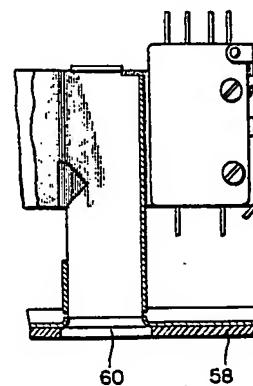
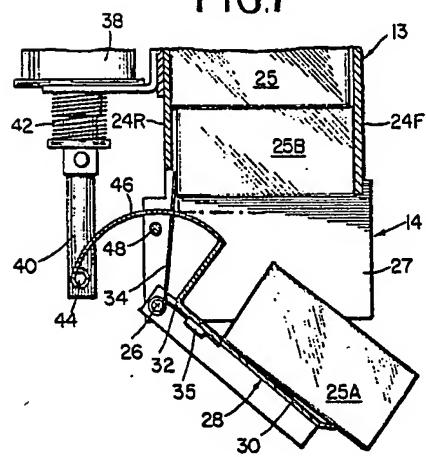


FIG. 7

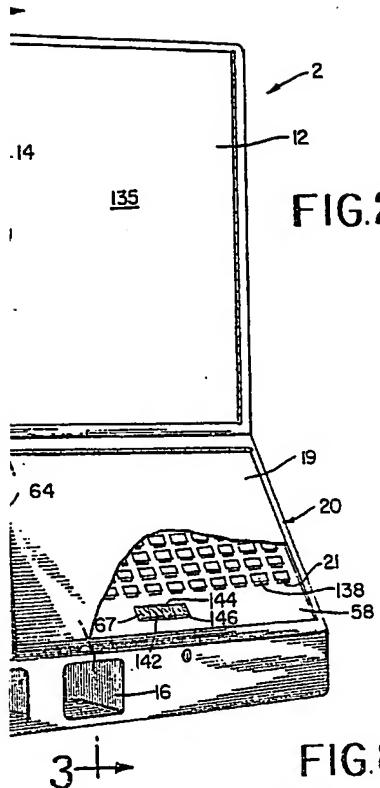


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## **COMPLETE SPECIFICATION**

This drawing is a reproduction of

Sheet 2



**FIG.2**

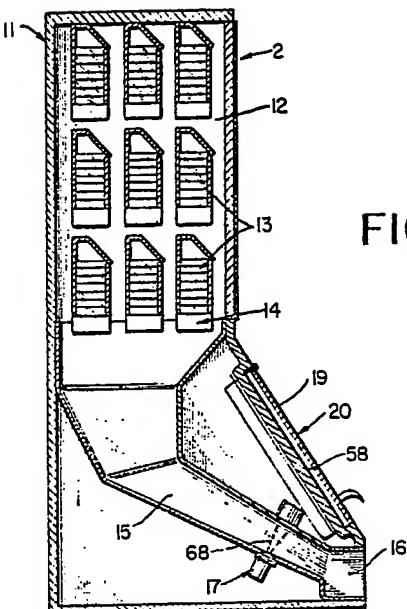


FIG.3

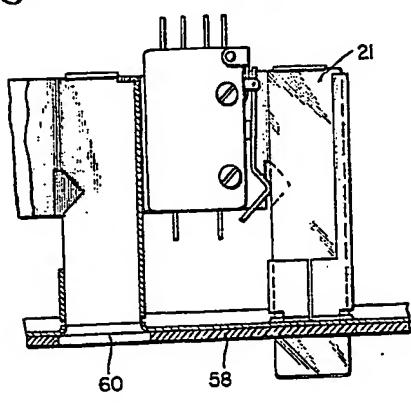
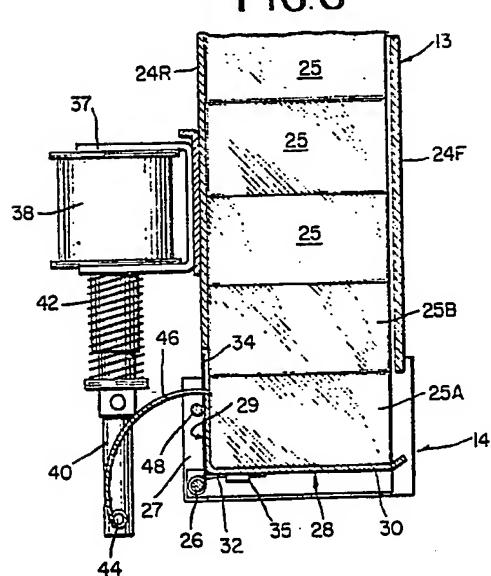
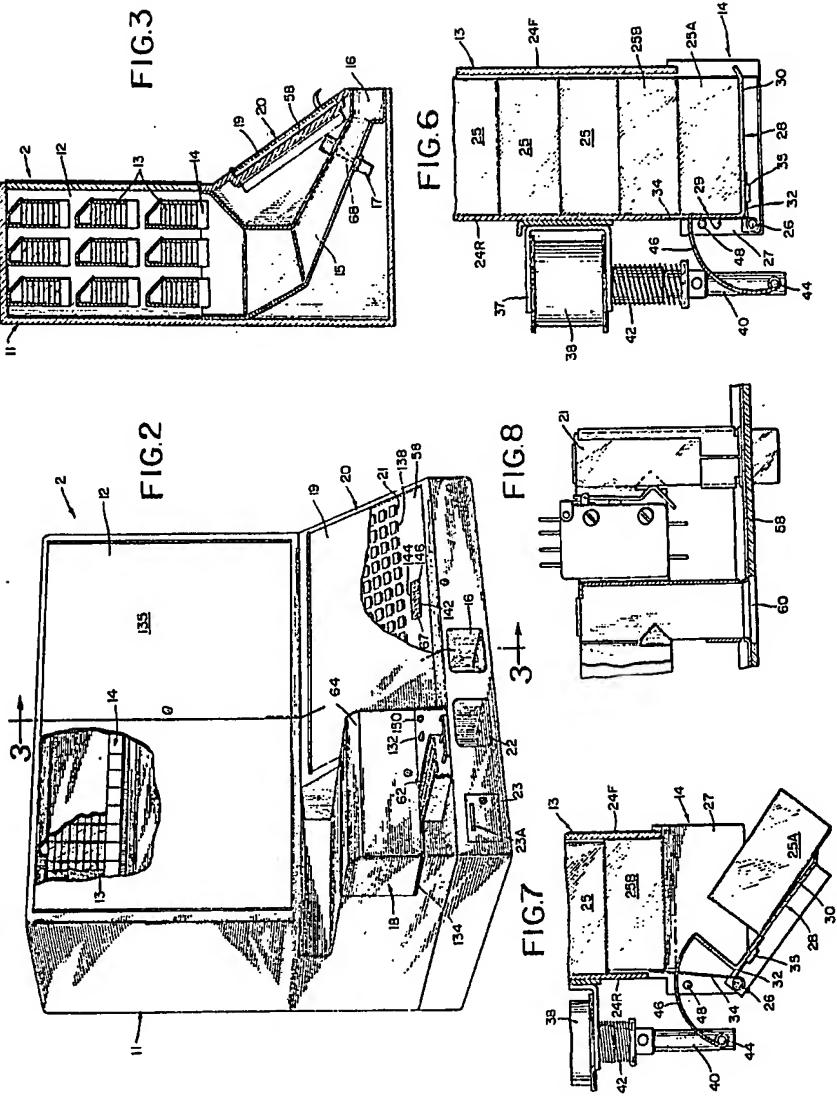


FIG.8





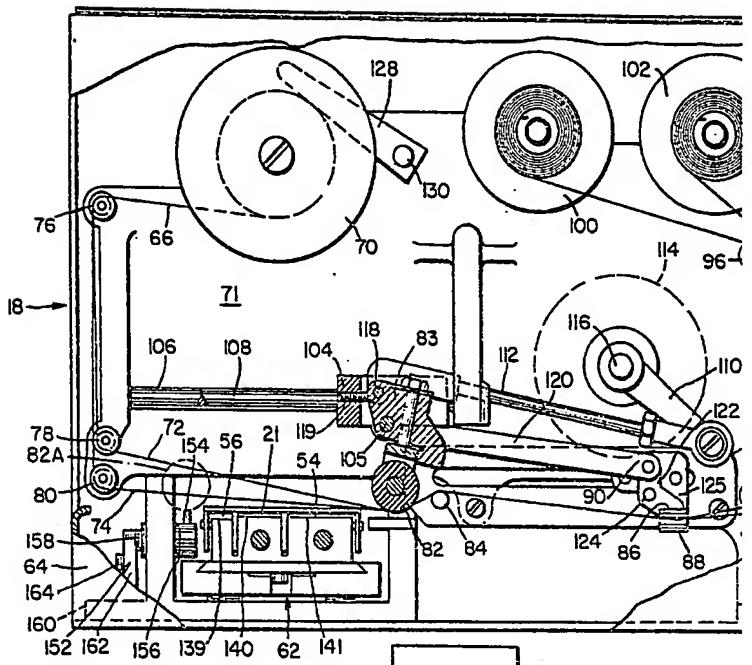
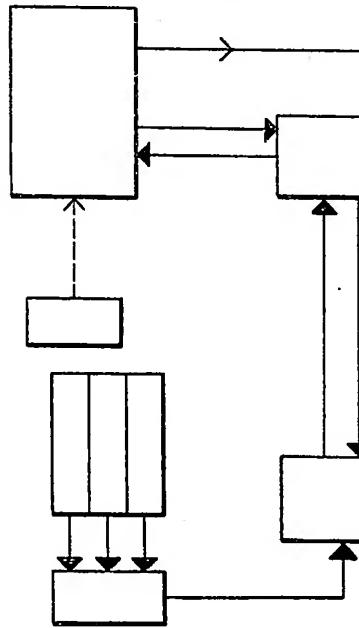


FIG. 4



996077 COMPLETE SPECIFICATION

6 SHEETS This drawing is a reproduction of

the Original on a reduced scale

Sheet 3

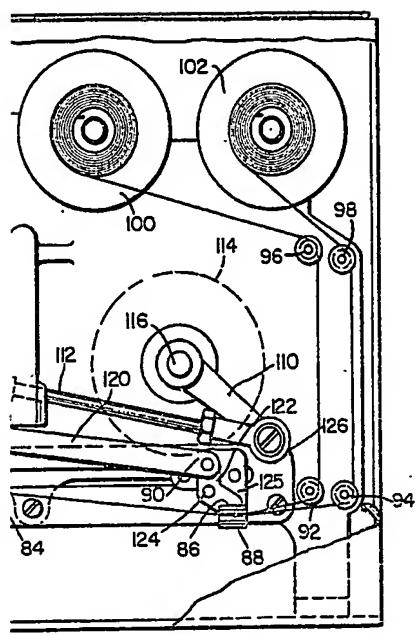


FIG.5

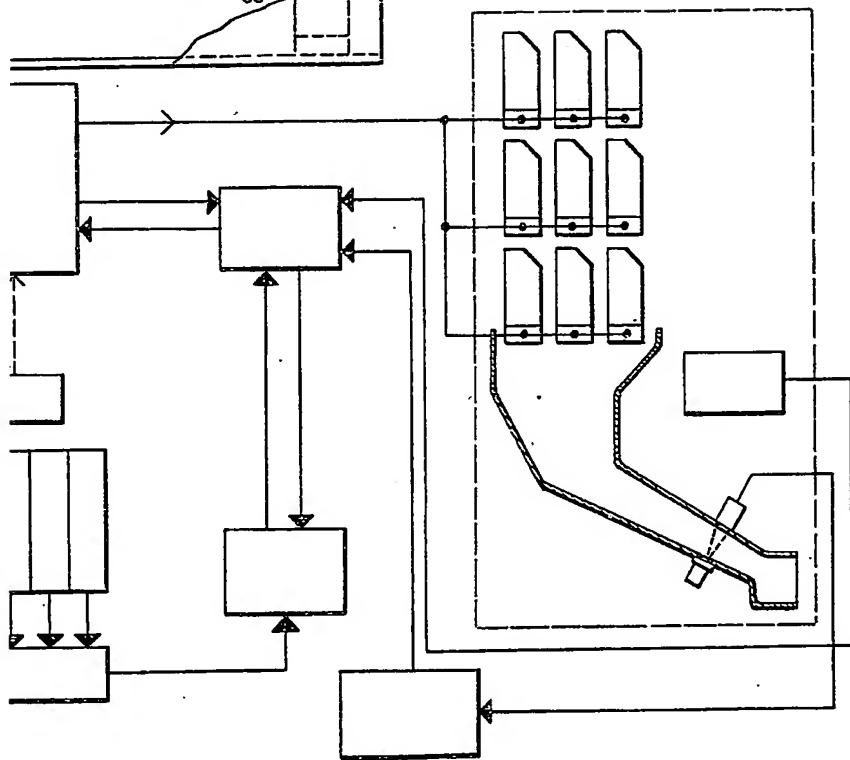
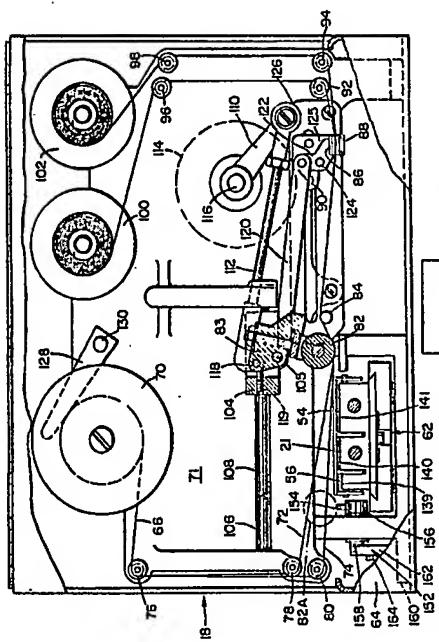
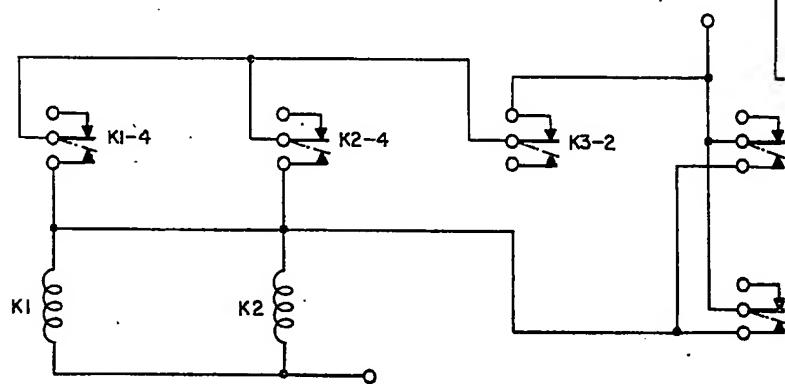
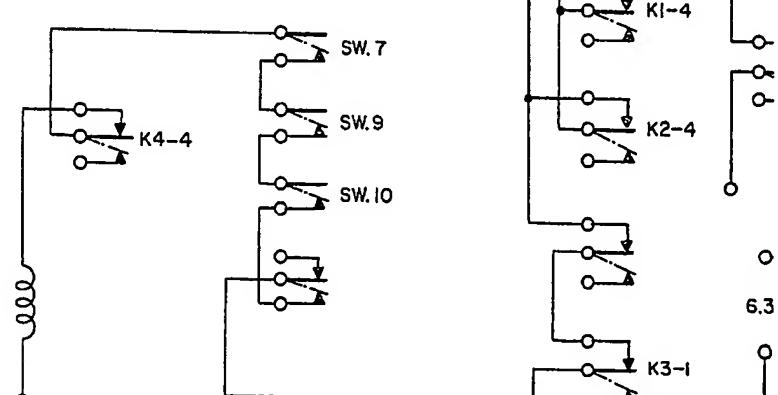
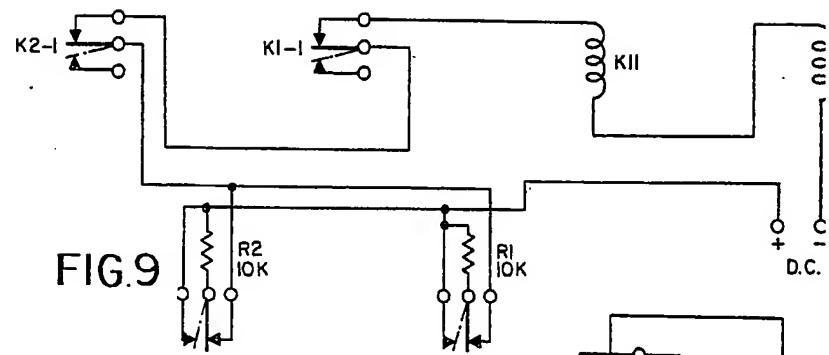


FIG.5





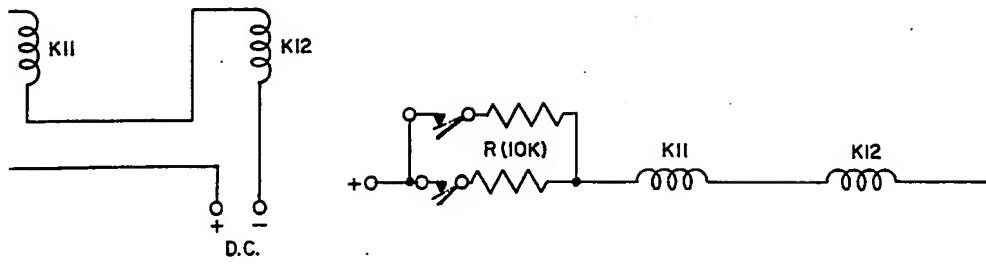


FIG.9A

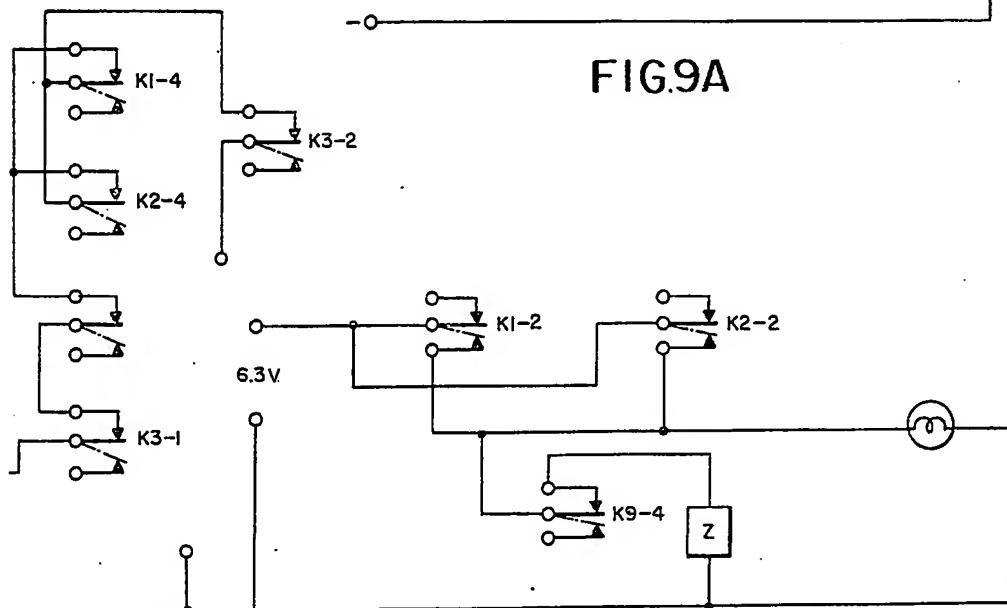


FIG.11

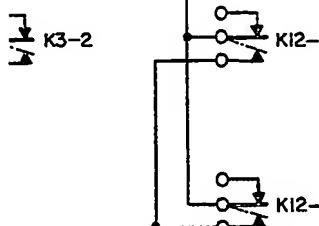


FIG.10

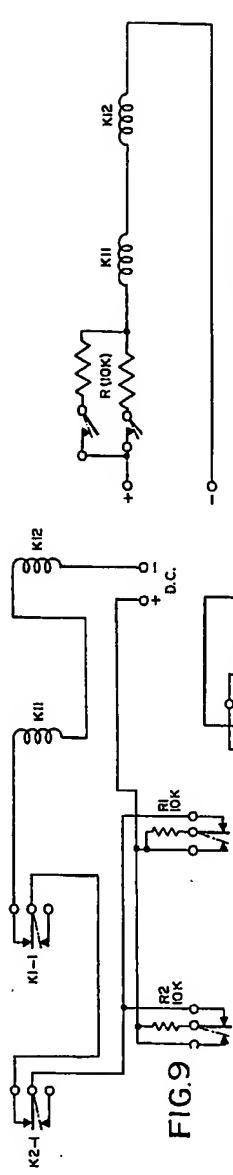


FIG.9A

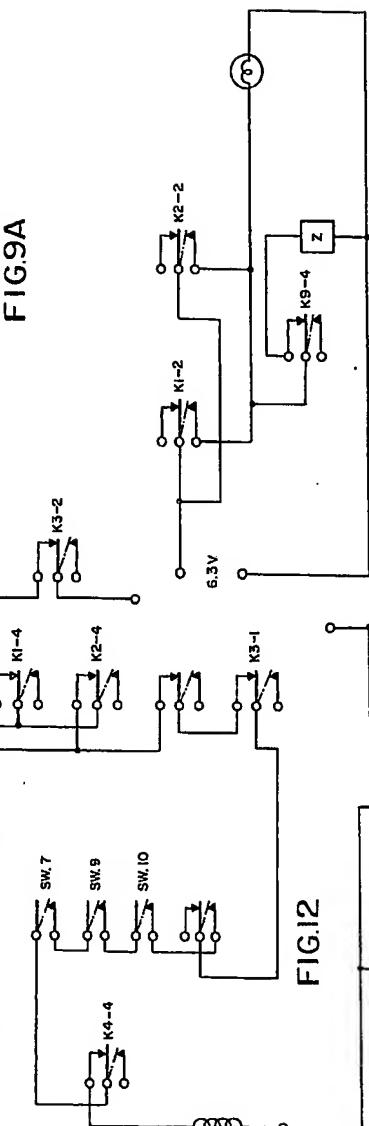


FIG.11

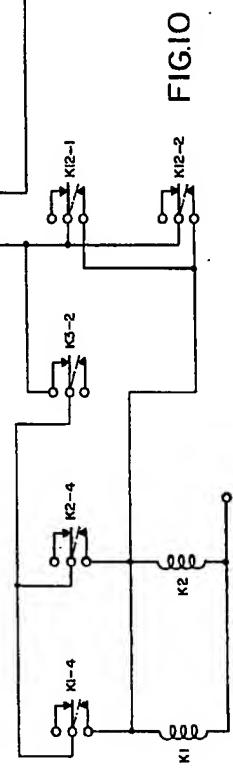


FIG.14

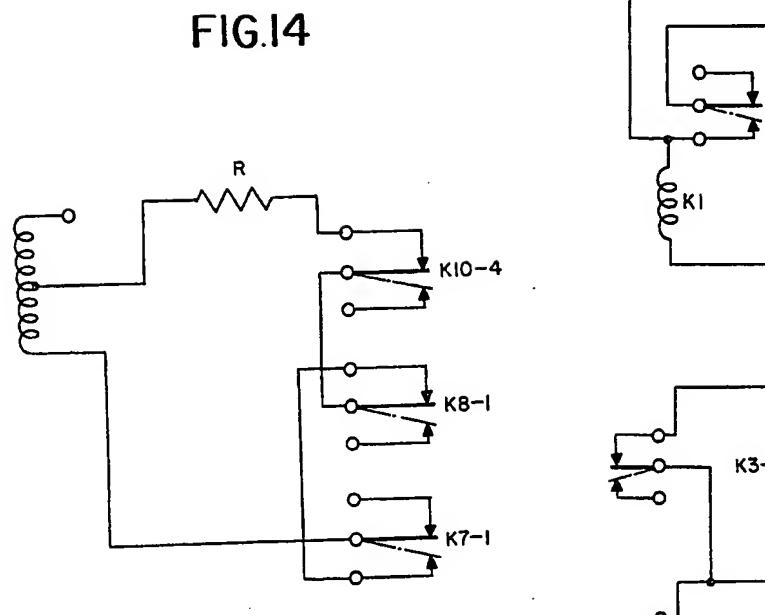
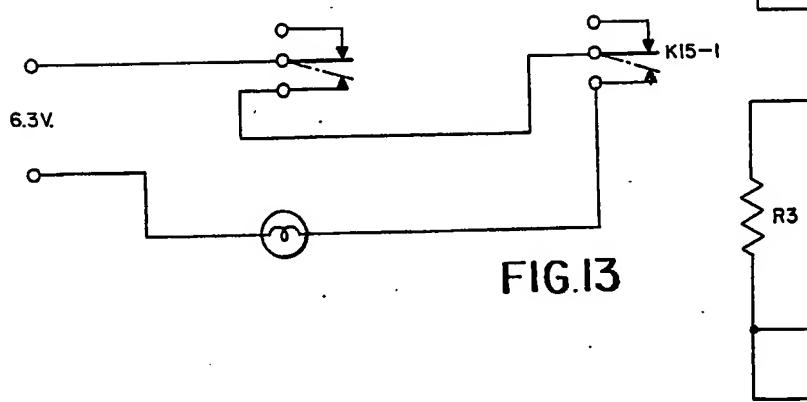


FIG.13



996077      COMPLETE SPECIFICATION  
 6 SHEETS      This drawing is a reproduction of  
 the Original on a reduced scale  
 Sheet 5

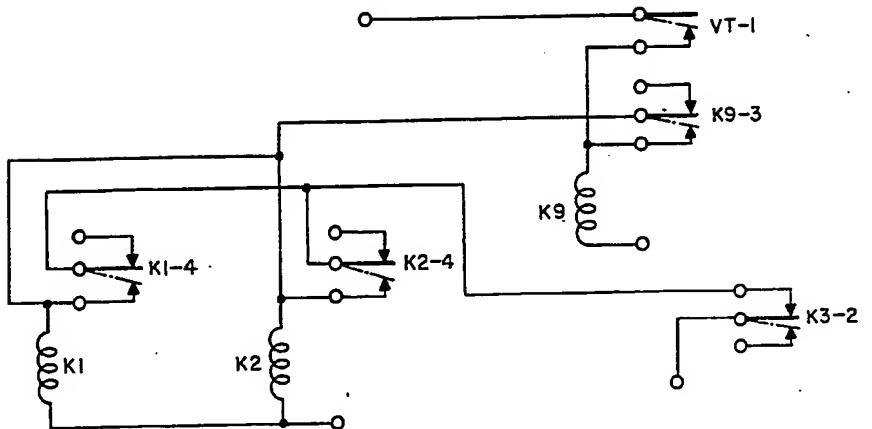


FIG.15

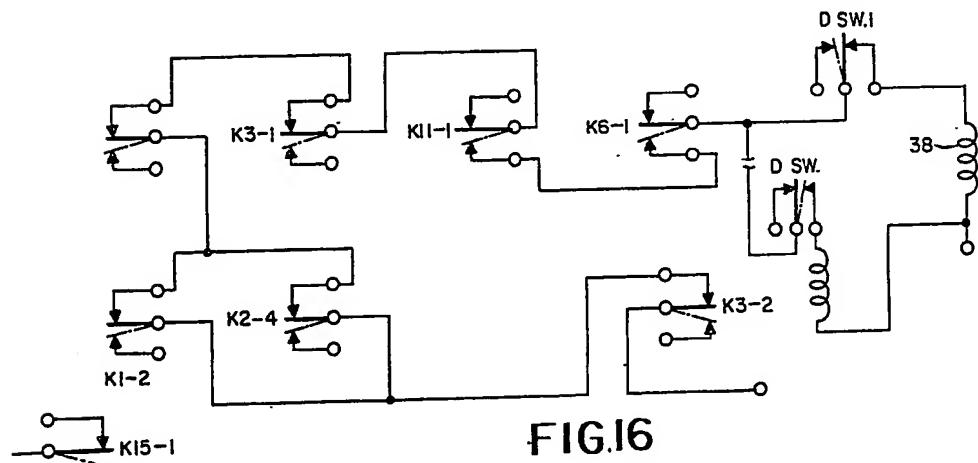


FIG.16

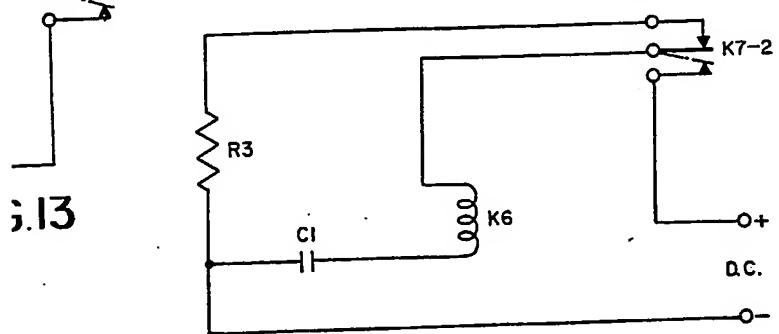


FIG.17

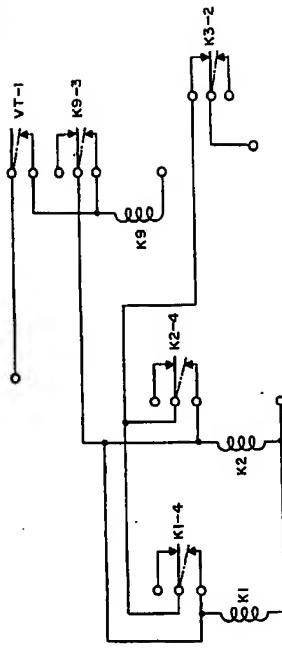


FIG.14

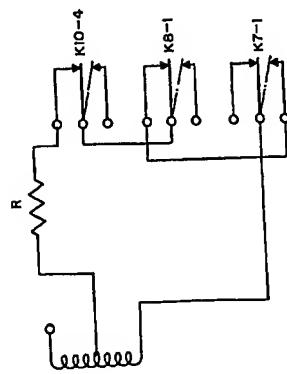


FIG.15

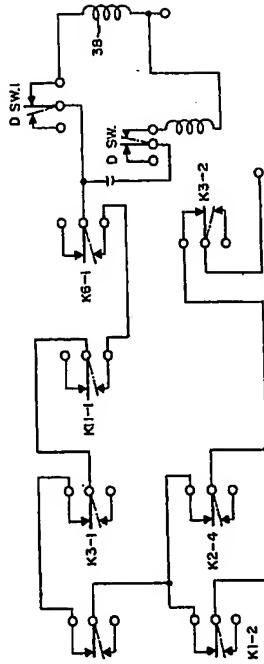


FIG.16

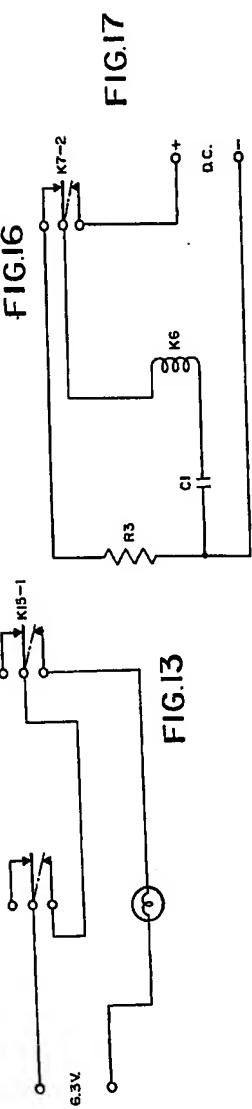


FIG.17

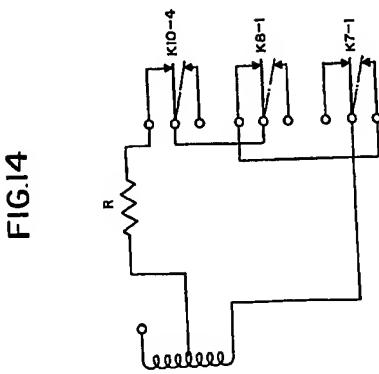


FIG.13

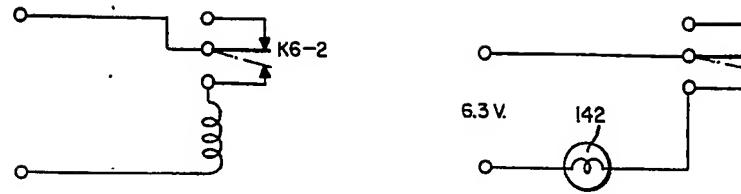


FIG.18

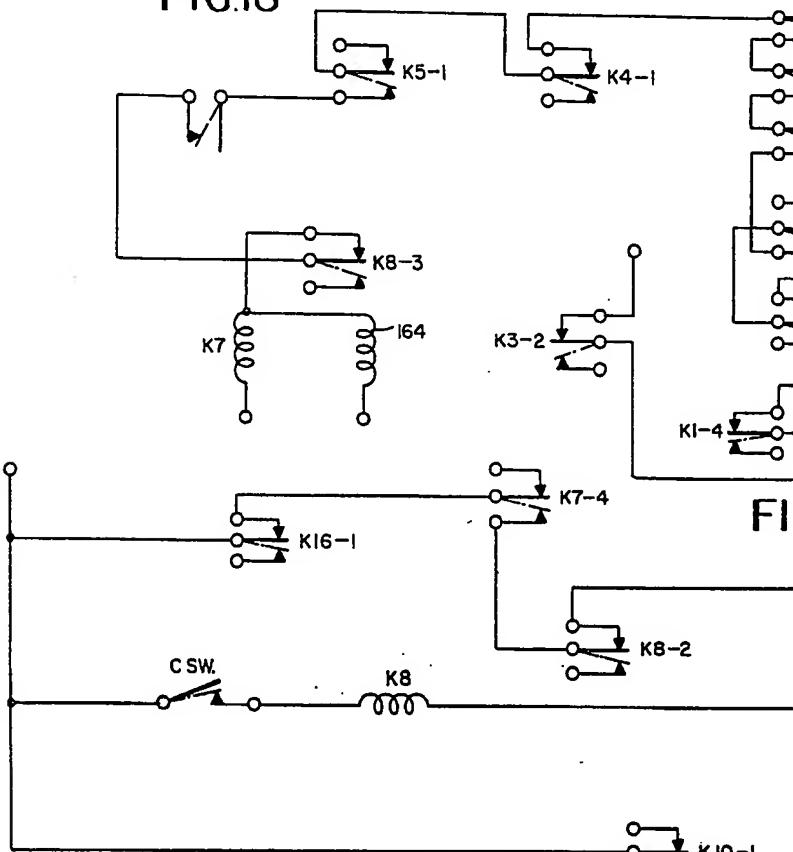


FIG.22

